

Claims

1. A method for implementing a filter comprising of a transmission line of one or more segments with fixed propagation delays for forward signal propagation or for feedback signal propagation.

For forward signal propagation, an input signal connected to a transmission line consisting of one or more segments with each segment providing its own fixed propagation delay. The nodes connecting said transmission line segments, the node at the input to the first delay segment and the node at the output of the last delay segment are connected to the inputs of one or more transconductance elements. When there are multiple outputs of the said transconductance elements, the said outputs are connected together to form the sum of the currents.

For feedback signal propagation, a method for implementing a filter comprising of an input signal connected to a transconductance element, whose output is connected to a shunt impedance element and to the input of a transmission line consisting of one or more segments with each segment providing its own fixed propagation delay. The nodes connecting the said transmission line segments and the node at the output of the last delay segment are connected to the inputs of one or more transconductance elements. When there are multiple outputs of the said transconductance elements, the said

outputs are connected together to form the sum of the currents for feeding back to the input of the said transmission line.

The said impedance element can be replaced by a serial transimpedance element whose input is connected to the output of the transconductors and whose output is connected to the input of the transmission line.

The said forward signal propagation transmission line filter and the said feedback signal propagation transmission line filter each separately or combined can form the implementation of a filter with any type of network, lattice, or cascaded filter structures.

2. The method of claim 1:

Wherein the number of transmission line segments are an integer, N , with $N > 1$;

Wherein the number of transconductance elements are an integer, M , with $M > 1$;

Wherein the input and output signals are single ended or differential;

Wherein the analog filter implementation is fixed, programmable, or adaptive.

3. The method of claim 1 wherein the transmission line segments are implemented on an integrated circuit device, off-chip, on a silicon or other semiconductor substrates, on the package substrate, on a PCB

board, as co-planar waveguides, as microstrip lines, as stripline transmission lines or any other known transmission line types.

4. The method of claim 1 wherein each of the transmission line segments can have its own fixed or programmable delay value.
5. The method of claim 1 wherein the number of the transmission line segments can be fixed or programmable.
6. The method of claim 1 wherein the transconductance elements are implemented as transconductance amplifiers, as multistage voltage amplifiers, resistors, or a combination of resistors and voltage amplifiers.
7. The method of claim 1 wherein the transconductance elements are implemented as fixed transconductance, as programmable transconductance, or as adaptively controlled transconductance.
8. The method of claim 1 wherein the impedance element comprises a resistor or resistors, capacitors, inductors or resistor, capacitor and inductor combination networks.
9. The method of claim 1 wherein the impedance element has fixed impedance, programmable impedance, or adaptively adjustable impedance.

10. The method of claim 1 wherein the transimpedance amplifier has fixed transimpedance, programmable transimpedance, or adaptively controlled transimpedance.

11. The method of claim 1 wherein matching components are placed at the inputs of the transconductance elements; wherein the impedance element comprises a resistor or resistors, capacitors, inductors or resistor, capacitor and inductor combination networks; wherein the impedance element has fixed impedance, programmable impedance, or adaptively adjustable impedance.

12. The method of claim 1 further comprises an impedance element whose input is connected to the outputs of said transconductance elements, wherein the impedance element comprises a resistor or resistors, capacitors, inductors or resistor, capacitor and inductor combination networks; wherein the impedance element has fixed impedance, programmable impedance, or adaptively adjustable impedance.

13. The method of claim 1 wherein the outputs of said transconductance elements are connected together at the input of a transimpedance amplifier wherein the transimpedance amplifier has fixed transimpedance, programmable transimpedance, or adaptively adjustable transimpedance.

14. The method of claim 1 wherein the transmission line is terminated by an impedance element, wherein the said impedance element is a network of resistors, capacitors, and inductor elements; wherein the impedance element has fixed impedance, programmable impedance, or adaptively adjustable impedance.

15. The method of claim 1 used in a feed-forward equalization (FFE) filter, a decision feedback equalization (DFE) filter, a finite impulse response (FIR) filter, an infinite impulse response (IIR) filter, an equalization filter, adaptive equalization filter, equalization filter for optical channels, equalization filter for electrical channels, a radio frequency filter for radio reception, or a radio frequency filter for radio transmission.